

# WHAT WE CLAIM IS:

1. A humidification apparatus for humidifying a gases flow to be supplied to a patient or other person in need of such gases comprising:

humidification chamber means and having an inlet and an outlet to allow said gases flow to pass through said humidification chamber means,

chamber heating means provided adjacent said humidification chamber means and adapted to vaporise liquid water in said humidification chamber means in order to provide water vapour to said gases flow passing through said humidification chamber means,

gases transportation pathway means connected to said outlet of said humidification chamber means to convey said gases flow to said patient or other person in need of such gases, and

humidity sensing means configured to provide an indication of the absolute humidity of said gases flow at least at one point in the flow path through said apparatus of said gases flow.

2. A humidification apparatus as claimed in claim 1 further comprising control means which receives as inputs the output from said humidity sensing means and said storage means configured to estimate the rate of condensation of the vapour from said gases in said gases transportation pathway means.

3. A humidification apparatus as claimed in claim 2 wherein said humidity sensing means including a first absolute humidity sensor in substantial proximity to said outlet of said humidification chamber means.

4. A humidification apparatus as claimed in claim 3 wherein said gases transportation pathway means having a patient end, distal to said end connected to said outlet of said humidification chamber means, and said humidity sensing means further comprising a second absolute humidity sensor in substantial proximity to said patient end of said gases transportation pathway means.

5. A humidification apparatus as claimed in claim 4 wherein said estimate of the rate of condensation is based on the difference between the absolute humidity at said outlet of said humidification chamber means, as indicated by the output of said first absolute humidity sensor, and the absolute humidity at said patient end of said gases transportation pathway means, as indicated by the output of said second absolute humidity sensor.

6. A humidification apparatus as claimed claim 5 wherein further comprising conduit heating means adapted to heat said gases flow in said gases transportation pathway means and/or said gases transportation pathway means, and said control means configured to energise said conduit heating means depending on at least said estimate of the rate of condensation, in order to minimise any condensation of the vapour from said gases in said gases transportation pathway means.

7. A humidification apparatus as claimed in claim 5 further comprising conduit heating means adapted to heat said gases flow in said gases transportation pathway means and/or said gases transportation pathway means, and said control means configured to:

- i) energise said conduit heating means depending on at least said estimate of the rate of condensation, to a level appropriate to substantially vaporise any liquid condensate present in said gases transportation pathway means; and
- ii) energise said conduit heating means depending on at least said estimate of the rate of condensation, to a level appropriate to minimise any condensation of the vapour from said gases in said gases transportation pathway means.

8. A humidification apparatus as claimed in claim 7 said steps (i) and (ii) are repeated continually at regular intervals.

9. A humidification apparatus as claimed in claim 7 wherein said steps (i) and (ii) are alternated at regular intervals.

10. A humidification apparatus as claimed in claim 2 wherein said gases transportation

pathway means having a patient end, distal to said end connected to said outlet of said humidification chamber means said humidity sensing means comprising a first temperature sensor in substantial proximity to said outlet of said humidification chamber means and an absolute humidity sensor in substantial proximity to said patient end of said gases transportation pathway means.

11. A humidification apparatus as claimed in claim 10 further comprising conduit heating means adapted to heat said gases flow in said gases transportation pathway means and/or said gases transportation pathway means, and said control means configured to energise said conduit heating means depending on at least said estimate of the rate of condensation, at a level appropriate to minimise any condensation of the vapour from said gases in said gases transportation pathway means as well as convey said gases flow to said patient or other person in need of such gases substantially at a predetermined level of absolute humidity.

12. A humidification apparatus as claimed in claim 2 wherein said humidity sensing means comprising at least a temperature sensor and at least one relative humidity sensor providing an indication of the temperature and relative humidity at least at one point in the flow path of said gases flow through said apparatus.

13. A humidification apparatus as claimed in claim 2 wherein further comprising flow sensing means adapted to provide an indication of the rate of flow of said gases flown through said apparatus.

14. A humidification apparatus as claimed in claim 13 wherein said flow sensing means comprising a heated element adapted to maintain a substantially constant temperature and being provided in the flow path of said gases through said apparatus, the heat loss therefrom providing an indication of the rate of flow of said gases.

15. A humidification apparatus as claimed in claims 1 or 2 wherein said humidity sensing

means further comprising disposable cover means for providing a substantial barrier to microorganisms between said flow of gases and said temperature sensor.

16. A humidification apparatus as claimed in claims 1 or 2 wherein said humidity sensing means further comprising porous disposable cover means for providing porous material as a substantial barrier to microorganisms between said flow of gases and said absolute humidity sensor.

17. A humidification apparatus for humidifying a gases flow to be supplied to a patient or other person in need of such gases comprising:

humidification chamber means and having an inlet and an outlet to allow said gases flow to pass through said humidification chamber means,

chamber heating means provided adjacent said humidification chamber means including wet heating means adapted to vaporise liquid water in said humidification chamber means in order to provide water vapour to said gases flow passing through said humidification chamber means and dry heating means adapted to directly heat said gases flow passing through said humidification chamber means,

gases transportation pathway means connected to said outlet of said humidification chamber means to convey said gases flow to said patient or other person in need of such gases, and

control means configured to energise said wet heating means and said dry heating means to achieve a desired level of absolute humidity.

18. A humidification apparatus as claimed in claim 17 wherein said apparatus further comprising humidity sensing means for providing an indication of the absolute humidity of said gases flow at least one point in the flow path through said apparatus of said gases flow.

19. A humidification apparatus as claimed in claims 17 or 18 wherein said chamber heating means comprises a metal spiral element.

20. A humidification apparatus as claimed in claims 17 or 18 wherein said chamber heating means comprises a heated porous ceramic member adapted to be in contact with said liquid water and said gases flow.
21. A humidification apparatus as claimed in claims 17 or 18 wherein heating means comprises a heated semipermeable membrane adapted to be in contact with said liquid water and said gases flow.
22. A humidification apparatus as claimed in claim 17 wherein said humidification chamber means further having a humidification bypass means, for allowing a portion of said gases to flow to pass from said inlet of said humidification chamber means to said outlet of said humidification chamber means substantially without humidification.
23. A humidification apparatus as claimed in claim 22 wherein said humidification bypass including a bypass conduit in at least partially passing through said quantity of water for conveying a portion of said gases flow from said inlet of said humidification chamber means to said outlet of said humidification chamber means, and a valve means provided in said bypass conduit means to thereby control the flow rate of the portion of said gases flow in said bypass conduit means, the temperature of gases flowing through said bypass conduit means being affected by the temperature of said quantity of water.
24. A humidification apparatus as claimed in claim 22 wherein said humidification chamber means further having a bypass conduit means for conveying a portion of said gases flow from said inlet of said humidification chamber means to said outlet of said humidification chamber means including a bypass heating means adapted to heat the portion of said gases flow in said bypass conduit means and/or said bypass conduit means, and a valve means provided in said bypass conduit means to thereby control the flow rate of the portion of said gases flow in said bypass conduit means.
25. A humidification apparatus as claimed in claims 23 or 24 wherein the restriction

provided by said valve means on the flow rate of the portion of said gases flow in said bypass conduit means is in use permanently set.

26. A humidification apparatus as claimed in claims 23 or 24 wherein the restriction provided by said valve means on the flow rate of the portion of said gases flow in said bypass conduit means is in use manually adjustable.

27. A humidification apparatus as claimed in claims 23 or 24 further comprising flow sensing means providing an indication of the instantaneous flow rate wherein said control configured to control the restriction provided by said valve means on the flow rate of the portion of said gases flow in said bypass conduit means based on said indication of instantaneous flow rate of said gases flow through said humidification chamber means, in order that the gases flow exiting from said humidification chamber means is of substantially constant humidity.

28. A humidification apparatus as claimed in claims 23 or 24 wherein said valve means comprising an electromechanical actuator connected to a valve member wherein the energisation of said electromechanical actuator varies the position of said valve member thereby varying the restriction provided by said valve means on the flow rate of the portion of said gases flow in said bypass conduit means.

29. A humidification apparatus as claimed in claims 23 or 24 wherein said valve means comprising either a valve member connected to an elastic member or an elastic valve member wherein said valve being positioned in said gases flow at said inlet to humidification chamber means and the position of said valve member or said elastic valve member thereby determines the portion of said gases flow in said bypass conduit means.

30. A humidification apparatus as claimed in claim 29 wherein the position of said valve member or said elastic valve member providing an indication of the rate of flow of said gases flow at said inlet to humidification chamber means.

31. A humidification apparatus as claimed in claims 17 or 18 further comprising gases heating means adjacent to said inlet of said humidification chamber means, for heating of said flow of gases prior to being humidified.

32. A humidification apparatus as claimed in claims 17 or 18 wherein said apparatus further comprising gases heating means adjacent to said outlet of said humidification chamber means, for heating of said flow of gases subsequent to being humidified.

33. A humidification apparatus as claimed in claims 17 or 18 wherein said gases transportation pathway means includes insulation means adapted to minimise the rate of heat energy lost by said gases flow in said gases transportation pathway means, said control means adapted to energise said chamber heating means to minimise the condensation of the vapour from said gases in said gases transportation pathway means while providing predetermined levels of absolute humidity.

34. A humidification apparatus for humidifying a gases flow to be supplied to a patient or other person in need of such gases comprising:

humidification chamber means and having an inlet and an outlet to allow said gases flow to pass through said humidification chamber means,

chamber heating means provided adjacent said humidification chamber means and adapted to vaporise liquid water in said humidification chamber means in order to provide water vapour to said gases flow passing through said humidification chamber means,

gases transportation pathway means connected to said outlet of said humidification chamber means to convey said gases flow to said patient or other person in need of such gases, and

regulated conduit heating means adapted to regulate the temperature profile of said gases flow along said gases transportation pathway means and/or of said gases transportation pathway means, to substantially coincide with a predetermined profile.

35. A humidification apparatus as claimed in claim 34 wherein said regulated conduit

heating means comprising at least one section of positive temperature coefficient material wherein the localised electrical resistance of each said section is positively related to the localised temperature.

36. A humidification apparatus as claimed in claim 34 wherein said regulated conduit heating means comprising at least one section of negative temperature coefficient material wherein the localised electrical resistance of said section is negatively related to the localised temperature.

37. A humidification apparatus as claimed in claim 34 wherein said regulated conduit heating means comprising a plurality of sections of positive temperature coefficient material wherein the localised electrical resistance of each said section is positively related to the localised temperature section and at least two electrical conductors running along said gases transportation pathway means, each said conductor being electrically connected to a separate portion of each said section and each said section being electrically isolated from all other sections except for the connection through each said conductor.

38. A humidification apparatus as claimed in claim 34 wherein said gases transportation pathway means further comprising an inspiratory conduit means in fluid communication with said outlet of said humidification chamber, a connector means in fluid communication with said inspiratory conduit means, a flexible tube extension means in fluid communication with said connector means and patient interface means in fluid communication with said flexible tube extension means adapted to convey said gases flow to said patient.

39. A humidification apparatus as claimed in claim 38 wherein said flexible tube extension means including flexible tube extension heating means with at least one section of positive temperature coefficient material wherein the localised electrical resistance of said material is positively related to the localised temperature

40. A humidification apparatus as claimed in claims 38 or 39 wherein said patient interface



means comprising patient interface heating means including at least one section of positive temperature coefficient material wherein the localised electrical resistance of each said section of said material is positively related to the localised temperature.

41. A humidification apparatus as claimed in claim 34 further comprising humidity sensing means for providing an indication of the absolute humidity of said gases flow at said outlet of said humidity chamber means.

42. A humidification apparatus as claimed in claims 41 wherein further comprising temperature sensing means for providing an indication of the temperature of said gases flow at said outlet of said humidity chamber means.

43. A humidification apparatus as claimed in claim 34 wherein said gases transportation pathway means comprising a double walled inspiratory conduit and said regulated conduit heating means comprising the provision of warm fluid circulated between the inner wall and outer wall of said double walled inspiratory conduit.

44. A humidification apparatus as claimed in claims 34 wherein said predetermined profile relates to a substantially constant temperature along the length of said gases transportation pathway means.

45. A humidification apparatus for humidifying a gases flow to be supplied to a patient or other person in need of such gases comprising:

humidification chamber means and having an inlet and an outlet to allow said gases flow to pass through said humidification chamber means,

chamber heating means provided adjacent said humidification chamber means and adapted to vaporise liquid water in said humidification chamber means in order to provide water vapour to said gases flow passing through said humidification chamber means, and

chamber manifold means including mounting means in use housing at least one sensing means in proximity to said outlet of said humidification chamber means to connect:

said inlet of said humidification chamber means to a supply conduit means said supply conduit means in use in fluid communication with a gases supply means for supplying said gases flow at a desired pressure, and/or

said outlet of said humidification chamber means to a gases transportation pathway means for conveying said gases flow to said patient or other person in need of such gases.

46. A humidification apparatus as claimed in claim 45 wherein said chamber manifold means further including chamber manifold heating means adapted to heat said gases flow through said chamber manifold means and/or said chamber manifold means.

47. A humidification apparatus as claimed in claims 45 or 46 wherein said chamber manifold means is attachable to and removable from said humidification chamber means.